



Pilgrim Creek Restoration Project: Bird Community and Vegetation Structure

2004 Annual Report



Prepared for:

**State of California
Department of Transportation
District 11
San Diego, California**

**U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
WESTERN ECOLOGICAL RESEARCH CENTER**

Pilgrim Creek Restoration Project: Bird Community and Vegetation Structure

By Barbara E. Kus, Jeannie Guzis, and Mike Wellik

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San Diego Field Station
USGS Western Ecological Research Center
4165 Spruance Road, Suite 200
San Diego, CA 92101

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GALE A. NORTON, SECRETARY

U.S. GEOLOGICAL SURVEY
P. Patrick Leahy, Acting Director

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For additional information, contact:

Center Director
Western Ecological Research Center
U.S. Geological Survey
3020 State University Drive East
Modoc Hall, Room 3006
Sacramento, CA 98519

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I. INTRODUCTION

This report summarizes the results of bird and vegetation monitoring conducted in 2004 as part of a continuing project assessing the Pilgrim Creek Habitat Mitigation Site in San Diego County, California. The Mitigation Site supports natural stands of riparian and coastal sage scrub habitat, as well as planted vegetation intended to restore former expanses of these two habitat types in areas converted by agriculture. Protection of the existing habitats through acquisition, and the restoration of natural communities at the site, were undertaken as mitigation for impacts to riparian and coastal sage scrub habitat produced by a nearby highway expansion project (CalTrans 1995). The objective of the current monitoring is twofold: (1) monitor the status and productivity of Least Bell's Vireo (*Vireo bellii pusillus*), a State and Federally endangered riparian obligate, and (2) evaluate the structural development of planted vegetation in the riparian restoration site with regard to its suitability for nesting vireos. This report represents the seventh and final annual evaluation by CalTrans to track progress towards the goal of creating habitat with the structural and functional attributes of natural riparian habitat (Kus 1997).

II. STUDY SITE AND METHODS

A. STUDY SITE

The study site is located along Pilgrim Creek, a tributary to the San Luis Rey River in northern San Diego County. The site is bordered to the west by Marine Corps Base Camp Pendleton, to the south by a golf course, and on the remaining sides by Douglas Drive and residential developments. The stretch of Pilgrim Creek on the site supports approximately 7 ha of willow-dominated riparian habitat along a narrow channel. Coastal sage scrub, including 14 ha of restored habitat, covers the slopes bordering the site to the west, and the center of the site supports riparian vegetation planted in 1996 within a 17-ha restoration area, as well as a 0.6-ha freshwater marsh. An additional small cell of planted riparian vegetation lies between Pilgrim Creek and Douglas Drive on the east side of the river.

B. METHODS

1. Least Bell's Vireo Monitoring

Least Bell's Vireos were monitored between 1 April and 15 August 2004. Surveys were initiated early in the spring to determine the number, location and breeding status (paired or unpaired) of all singing males within the study area. Once pairs were located, they were observed for evidence of nesting. Nest locations were determined, and nests monitored throughout the period that they were active. Nests were checked during afternoon hours, and their contents observed using mirrors suspended over the nest from distances of 1-2 m. Any cowbird eggs or young discovered in vireo nests were removed. Nests were visited as infrequently as possible to minimize disturbance to the vireos, and the potential for attracting predators or cowbirds to nest sites. Typically, the first one or two visits to a nest were timed to determine the number of eggs laid, and the next to determine the number and ages of nestlings

present. Territories were visited throughout the season, and an attempt made to determine the number and fate of all nests produced.

Characteristics of nest sites were measured following abandonment of nests. Nest height to the nearest cm was recorded as the distance between the ground and the nest rim. The species of plant supporting the nest was also recorded.

Selected adults, mostly males, were captured in mist nets placed in the bird's territory, using song playbacks to draw the bird into the net. Any birds banded previously as nestlings at Pilgrim Creek or elsewhere were captured to determine identity, age, and natal history, and to re-band with a unique combination. Nestlings were not banded in 2004 because the study was ending.

2. Vegetation Structure

Vegetation data were collected at points along permanently marked transects running perpendicular to Pilgrim Creek and arrayed to provide uniform coverage of the restoration site (Figure 1). Twenty-four transects were established in 1997 in habitat to the west of the river, and measured annually. An additional four transects were established in the restored habitat east of the creek in 1998 and measured annually thereafter. A total of 506 quads spaced at 10-m intervals along the transects were measured, yielding a sampling density of 30 quads per hectare (12 per acre). Foliage volume at 1-m height intervals was estimated using the "stacked cube" method, developed specifically to characterize canopy architecture in structurally diverse riparian habitat. By this method, field workers record percent cover of vegetation, by species, within 2- by 2- by 1-m high sampling volumes "stacked" vertically between the ground and the top of the canopy above the point. Four 2-m lengths of PVC pipe are placed on the ground to define the quadrat boundaries, and connectible lengths of PVC, marked at 1-m intervals, are used to determine height within the canopy. Percent cover is scored in the field using a modified Daubenmire (1959) scale with cover classes < 1, 1-10, 11-25, 26-50, 51-75, 76-90, and >90 percent. For analysis, cover codes were converted to class midpoints, which were then used to quantify vegetation structure at each sampling point, within each planting cell, and for the site as a whole.

In addition, vegetation structure data were collected at 54 points along 16 transects within the mature riparian habitat along Pilgrim Creek to provide a reference for the restored habitat, and to facilitate analyses examining relationships between habitat structure and bird densities in both sites.

Because the Least Bell's vireo is the primary target of the mitigation project, habitat within the restoration site was assessed with regard to its suitability as vireo nesting habitat by comparing it to a model quantifying vireo habitat at major breeding populations in San Diego County (Kus 1998). The model was developed as a tool for evaluating whether sites unoccupied by vireos supported habitat suitable for nesting; that is, does the site fall within the range of habitat structure found within vireo nesting territories? The criteria established for making this



Figure 1. Vegetation transects and irrigation cells, Pilgrim Creek restoration site.

determination requires that average cover at each height in the site under consideration fall within two standard deviations of the corresponding averages for known vireo nesting habitat, a range representing the 95 percent confidence interval of each mean (Snedecor and Cochran 1976). Sites failing to meet these criteria are considered unsuitable as nest sites for vireos.

III. RESULTS AND DISCUSSION

A. Least Bell's Vireo Monitoring

1. Population Size and Composition

The Least Bell's vireo population within the study site numbered 23 territorial males in 2004, all of which were paired (Figure 2, Table 1). In addition, one transient pair was observed on 12 May in area 14 (Figure 2) but not seen again, and one transient male was observed early in the season in area 16 (Figure 2); this male may have eventually settled in Territory 17 (Figure 2). The overall population increased by 10% from 2003, when 21 territories were present (Kus *et al.* 2004), while the breeding population (number of pairs) increased by 15% from 20 pairs present in 2003. All of the 23 pairs were monitored for nesting activity in 2004.

Eleven territories were established within the restored riparian habitat (Figure 2), identical to the number in restored habitat in 2003 (Kus *et al.* 2004). In addition, Transient 16 occupied habitat in Cell 16 early in the season, and Transient Pair 14 was observed in Cell 5. Eight of the 11 territories were situated entirely within restored vegetation (Territories 11, 15, 18, 19, 20, 21, 22 and 23), while three territories (9, 17, and 25) were made up of 50% or less planted vegetation and the rest mature woodland. Vireos occupied sites used in previous years and expanded their use of the restored habitat to include the areas with Territories 19 and 20 (Figure 2). All of the territories in restored habitat were occupied by nesting pairs. A total of 12 completed nests were located in restored vegetation, of which five (42%) fledged young; four nests were placed in mature habitat, of which one (25%) was successful.

Eighteen of the 25 males (including Transients 16 and 14), and 15 of the 24 females, were observed closely enough to determine whether or not they were banded. Of these, four males and two females carried bands (Table 2). One of the males (Territory 24, Table 2) was originally banded as a nestling in 2000 near Whelan Lake on the San Luis Rey River, approximately 3.5 km from the Pilgrim Creek study site, and was present at Pilgrim Creek in 2002 and 2003. A second male (Territory 5) was banded as a nestling at Pilgrim Creek in 2000, and returned to breed at the site in 2001, 2002 and 2003. A third male (Territory 22) was banded as an adult at Pilgrim Creek in 2001, but had not been seen since then. A fourth male in Territory 7 was observed to be banded, but his full combination could not be determined; it is possible that this male is the same bird that has occupied the territory annually since he was banded as an adult in 1999. Of the banded females, one (Territory 24) was banded as an adult in the same territory in 2003, and the other was banded in 2004.



Figure 2. Least Bell's Vireo Territory Locations at Pilgrim Creek, 2004.

Table 1. Status and territory ID of Least Bell's Vireos, Pilgrim Creek, 2004.

Map Code	Status ^a	Comments ^b	Map Code	Status ^a	Comments ^b
1	P		14	P	Transient pair seen 12 May.
2	P		15	P	
3	P		16	T	May have settled in Territory 17.
4	P		17	P	
5	P	M=2140-39355	18	P	
6	P		19	P	
7	P	M=? ^d	20	P	
8	P		21	P	
9	P		22	P	M=2140-39365; F=2320-28306 ^c
10	P		23	P	
11	P		24	P	M=2190-52351; F=2140-39385
12	P		25	P	
13	P				

^aP = pair, S = single male.

^bM = male, F = female. Number is federal band number.

^cBanded in 2004.

^dMale banded, but full combination not determined.

2. Nesting Activity

a. Type and Number of Nests

A total of 35 completed nests were documented for the 23 monitored pairs. Seven of the 35 nests were not located, but the pairs were suspected of nesting, and were later observed with young fledglings in their territories. Of the 28 nests located, 26 were monitored. The remaining two nests were located, but could not be approached closely enough to observe their contents without creating a trail; one of these nests was in a dense patch of California wild rose (*Rosa californica*), and the other in poison oak (*Toxicodendron diversilobum*). Pairs averaged 1.5 completed nests over the course of the season, intermediate to the 1.4 completed nests per pair in 2002 (Kus *et al.* 2002) and the 1.6 in 2003 (Kus *et al.* 2004).

b. Nest Initiation

Nesting began in mid-April, with the first confirmed clutch laid on 15 April. Forty-eight percent (11/23) of pairs had initiated first nests by 30 April, lower than the 65% (13/20) that had initiated by that date in 2003 (Kus *et al.* 2004). Ninety-one percent of pairs (21/23) had initiated nests by 15 May, higher than the fraction (75%, 15/20) that had done so in 2003. All pairs had begun nesting by 30 May except one pair that initiated their first nest in early June. With the exception of this pair's nest, all nests after 30 May represented second or third attempts.

c. Nesting Effort by Pairs

Nesting was observed for all of the 23 monitored pairs (Table 3). Of the 35 nests produced by these pairs, 66% represented first nesting attempts, with the remainder representing

Table 2. Histories of banded Least Bell's Vireo males at Pilgrim Creek, 1996-2004.

1996			1997			1998			1999			2000			2001		
Band Number	Age (yrs)	Natal Site	Band Number	Age (yrs)	Natal Site	Band Number	Age (yrs)	Natal Site	Band Number	Age (yrs)	Natal Site	Band Number	Age (yrs)	Natal Site	Band Number	Age (yrs)	Natal Site
1890-35259	4	SLR ^c	→	5		→	6		→	7		→	8		→	9	
1650-30078	2	?															
2080-53440 ^a	AHY	?	→	≥ 2													
2080-53444	AHY	?	→	≥ 2		→	≥ 3										
			1960-42415	2	SLR	→	3		→	4		→	5		→	6	
			2080-53428	1	PIL	→	2		→	3							
			2070-14812	AHY	?	→	≥ 2		→	≥ 3							
			2070-14813	AHY	?	→	≥ 2										
			2070-14814	AHY	?	→	≥ 2		→	≥ 3							
			2070-14815	AHY	?	→	≥ 2		→	≥ 3							
			2070-14816	AHY	?												
			2070-14817	AHY	?	→	≥ 2										
			2070-14818	AHY	?	→	≥ 2		→	≥ 3		→	≥ 4		→	≥ 5	
			2070-14819	AHY	?												
			2070-14820	AHY	?	→	≥ 2										
			2070-14821	AHY	?												
			1650-60041	AHY	?												
						2070-14823	AHY	?	→	≥ 2		→	≥ 3		→	≥ 4	
						2070-14824	AHY	?									
						2070-14825	AHY	?									
						2070-14826	AHY	?									
						2070-14836	AHY										
						2070-14837	AHY	?	→	≥ 2							
						2070-14838	AHY										
						2070-14840 ^d	AHY										
						2070-14868	AHY	?	→	≥ 2							
						2070-14869	AHY	?	→	≥ 2							
									2070-14885	AHY	?	→	≥ 2		→	≥ 3	
									2070-14900	AHY	?						
									2140-39231 ^d	AHY	?						
												2190-52233	1	SLR			
												Mdb ^d	1	SLR			
												2140-39305 ^d	1	PIL			
												2140-39354	AHY	?			
												2140-39233	AHY	?	→	≥ 2	
												2140-39235	AHY	?			
												2140-39236	AHY	?	→	≥ 2	
															1710-58811 ^d	1	SWE
															2140-39355	1	PIL
															Mblk	1	PIL
															2140-39365	AHY	?

Table 2 (continued). Histories of banded Least Bell's Vireo males at Pilgrim Creek, 1996-2004.

1998			1999			2000			2001			2002			2003		
Band Number	Age (yrs)	Natal Site	Band Number	Age (yrs)	Natal Site	Band Number	Age (yrs)	Natal Site	Band Number	Age (yrs)	Natal Site	Band Number	Age (yrs)	Natal Site	Band Number	Age (yrs)	Natal Site
2070-14823	AHY	?	→	≥ 2		→	≥ 3		→	≥ 4		→	≥ 5		→	≥ 6	
2070-14824	AHY	?															
2070-14825	AHY	?															
2070-14826	AHY	?															
2070-14836	AHY																
2070-14837	AHY	?	→	≥ 2													
2070-14838	AHY																
2070-14840 ^d	AHY																
2070-14868	AHY	?	→	≥ 2													
2070-14869	AHY	?	→	≥ 2													
			2070-14885	AHY	?	→	≥ 2		→	≥ 3		→	≥ 4		→	≥ 5	
			2070-14900	AHY	?												
			2140-39231 ^d	AHY	?												
						2190-52233	1	SLR									
						Mdb ^d	1	SLR									
						2140-39305 ^d	1	PIL									
						2140-39354	AHY	?									
						2140-39233	AHY	?	→	≥ 2							
						2140-39235	AHY	?									
						2140-39236	AHY	?	→	≥ 2		→	≥ 3		→	≥ 4	
									1710-58811 ^d	1	SWE						
									2140-39355	1	PIL	→	2		→	3	
									Mblk	1	PIL						
									2140-39365	AHY	?						
												2190-52351	2	SLR	→	3	
															2140-39385 ^d	AHY	?

Table 2 (continued). Histories of banded Least Bell’s Vireo males at Pilgrim Creek, 1996-2004.

2004		
Band Number	Age (yrs)	Natal Site
→	4	
→	≥ 4	
→	4	
→	≥ 2	
<i>2320-28306</i>	AHY	?

^a*Band numbers in italics indicate adults banded that year at Pilgrim Creek.*
^b*AHY = adult of unknown age.*
^c*SLR = San Luis Rey River, SWE = Sweetwater River, PIL = Pilgrim Creek study area.*
^d*Sex = female.*

second and third attempts. Forty-eight percent (11/23) of pairs produced more than one nest in 2004, lower than the 60% of pairs in 2003 that renested (Kus *et al.* 2004). One pair, located in the restoration site (Territory 15, Figure 2) double-brooded (fledged young from more than one nest).

Table 3. Number of completed nests produced by Least Bell's Vireo pairs, Pilgrim Creek, 2004.

Number of Completed Nests	Number of Pairs
0	0 (0.00) ^a
1	12 (0.52)
2	10 (0.44)
3	1 (0.04)
Total	23

^aNumbers in parentheses are proportions of total pairs.

d. Nesting Success

Forty-six percent of known nests (13/28; "known" nests refers to 26 monitored nests and two nests known but not approached (see above)) successfully fledged young, lower than the average success rate documented for this population since monitoring began in 1996 ($\bar{x} = 52 \pm 14\%$, $N = 8$ years; Appendix 1). As in the past, the majority of nest failures were attributed to predation (87% of failed nests; Table 4). Six nests failed for undetermined reasons: three of these failed prior to confirmation of laying and may have been depredated, two were abandoned with eggs (three eggs each), and one in poison oak (Territory 9, Figure 2) was not monitored so the cause of failure undeterminable. Nest failure was higher during the nestling stage than the egg stage (Table 5), unlike in 2003 when failure was distributed fairly evenly between the egg and nestling stages.

Table 4. Cause of failure of unsuccessful Least Bell's Vireo nests, Pilgrim Creek, 2004.

Cause of Failure	Number of Nests
Predation	9
Parasitism	0
Other ^a	6
Total Failed Nests	15
Total Known Nests	28

^aSee text for explanation.

Table 5. Stage of failure of unsuccessful Least Bell's Vireo nests, Pilgrim Creek, 2004.

Stage of Failure	Number of Nests
Pre-laying/eggs ^a	3 (0.21) ^b
Eggs	2 (0.14)
Eggs/nestlings ^a	2 (0.14)
Nestlings	7 (0.50)
Total Failed Nests	14

^aExact stage of failure not known.

^bNumbers in parentheses are proportions of total number of failed nests.

e. *Parasitism by Brown-headed Cowbirds*

No instances of cowbird parasitism of vireo nests were observed in 2004.

f. *Reproductive Success and Productivity*

Clutch size (based on 20 unparasitized nests observed with full clutches) averaged 3.6 ± 0.5 eggs per nest (Table 6), comparable to that in 2003 (3.6 ± 0.7 ; Kus *et al.* 2004) and to the annual average of 3.4 ± 0.2 since 1996 ($N = 8$ years; Appendix 1). Hatching rates were similar in 2004 and 2003 (74% of eggs, 83% of nests with eggs), but fledging rates were lower than in 2003 (87% of nestlings, 88% of nests with nestlings). Overall, pairs produced 0.48 fledglings per egg, fewer than in 2003 (0.64 fledglings per egg), but comparable to the average of 0.51 ± 0.1 produced by pairs during the eight years since 1996.

Seasonal productivity of vireos averaged 2.3 fledglings per pair, equal to the average number of young fledged by pairs annually since 1996 (2.3 ± 0.7 ; Appendix 1). Eighty-three percent of pairs (19/23) fledged one or more vireo young in 2004, fewer than the 90% of pairs in 2003, but at the high end of the range (41-82%) in the previous seven years.

Table 6. Reproductive success and productivity of Least Bell's Vireos, Pilgrim Creek, 2004.

Parameter	Total Number
Nests with eggs	23
Eggs laid	80
Average clutch size ^a	3.6 ± 0.5
Hatchlings	61
Nests with hatchlings	19
Hatching success:	
Eggs ^b	76%
Nests ^c	83%
Fledglings	38
Nests with fledglings	12
Fledging success:	
Hatchlings ^d	62%
Nests ^e	63%
Fledglings per egg	0.48
Fledglings per nest ^f	1.49
Fledglings per pair	2.3
Pairs fledging \geq one young	83%

^aBased upon 20 non-parasitized nests seen with full clutches.

^bPercentage of all eggs that hatched.

^cPercentage of all nests in which at least one egg hatched.

^dPercentage of all hatchlings that fledged.

^ePercentage of all nests with hatchlings in which at least one young fledged.

^fIncludes 14 fledglings from seven nests not located.

3. Banding

One adult female in Territory 22 was captured and banded in 2004 while attempting to recapture her mate for identification (Table 1).

4. Nest Site Characteristics

The average height of vireo nests in the study area in 2004 was 0.79 ± 0.30 m (Table 7), comparable to previous years (Kus *et al.* 1999, 2000, 2001, 2002; Kus and Peterson 2002; Kus *et al.* 2004). Vireos placed nests in a total of ten different species, with the majority of nests placed in *Baccharis glutinosa* (mule fat) and *Salix lasiolepis* (arroyo willow).

Table 7. Plant species used as nest support by Least Bell's Vireos, Pilgrim Creek, 2004.

Species	Number of Nests
<i>Salix lasiolepis</i>	5
<i>Salix gooddingii</i>	4
<i>Salix exigua</i>	2
<i>Baccharis glutinosa</i>	6
<i>Rosa californica</i>	1
<i>Platanus racemosa</i>	3
<i>Populus fremontii</i>	1
<i>Rubus ursinus</i>	4
<i>Sambucus mexicana</i>	1
<i>Toxicodendron diversilobum</i>	1
Total	28

B. Vegetation Structure

1. 2003-2004

Foliage cover in the reference habitat along Pilgrim Creek was comparable to cover in 2003 (Kus et al. 2004) at heights up to 5 m with the exception of cover at 1-2 m, which declined slightly (Figure 3). Cover at heights above 5 m declined to approximately 60-70% of the cover measured in 2003. In contrast, cover in the restored habitat was comparable to that in 2003 or declined only slightly at heights above 2 m, and was approximately 80% of the cover measured below 2 m in 2003 (Figure 4). Nevertheless, the restored habitat continued to meet the habitat suitability model's criteria at all heights.

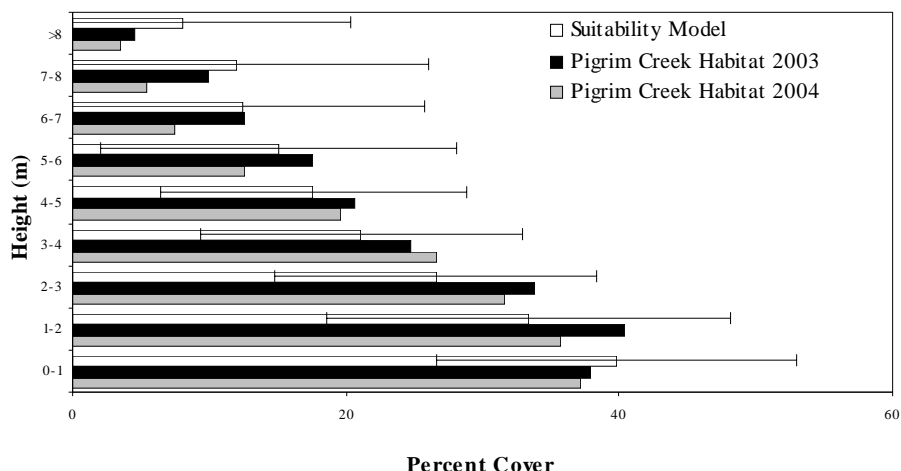


Figure 3. Average percent cover by height: Pilgrim Creek, 2003-2004.

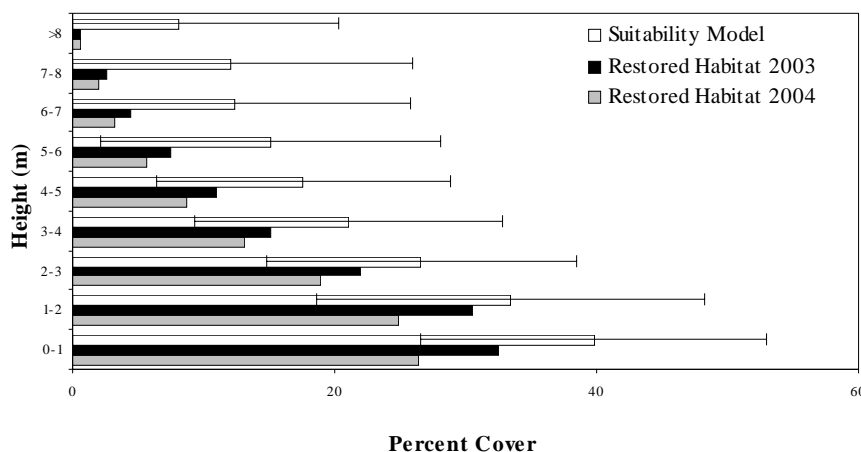


Figure 4. Average percent cover by height: restored habitat, 2003-2004.

Figure 5. Average percent cover by height of restored habitat: cell-by-cell assessment, 2003-2004

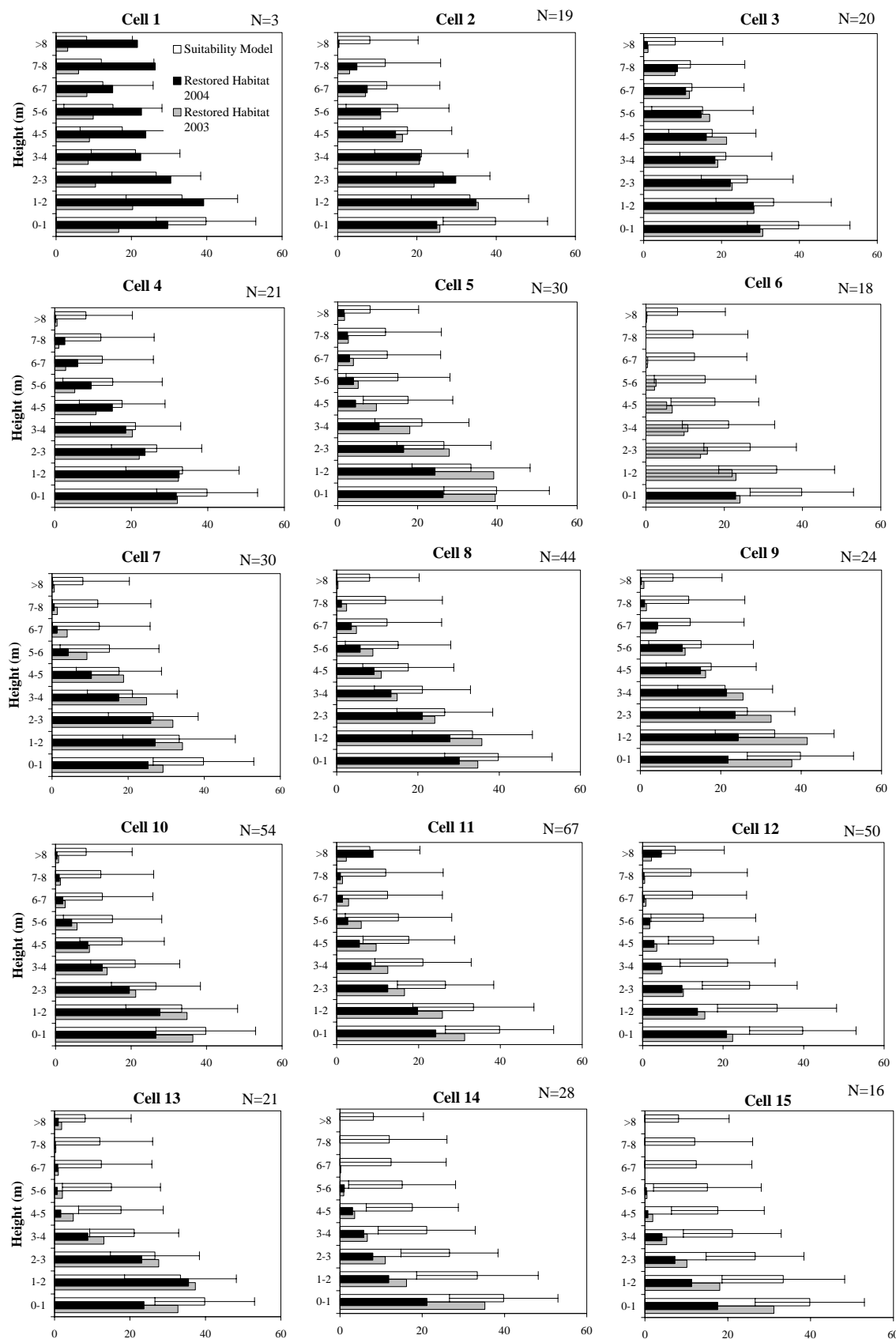
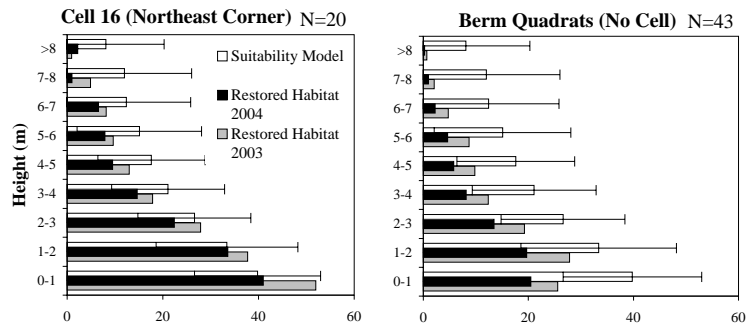


Figure 5 (cont.). Average percent cover by height of restored habitat: cell-by-cell assessment, 2003-2004.



Canopy cover in cells situated in the northern section of the restoration site (Cells 1-6) increased or was comparable to that in 2003 (Kus et al. 2004), while cover in the rest of the site (Cells 7-15) declined slightly (Figure 5). Declines in cover occurred primarily at heights below 2 m, probably a reflection of annual differences in herbaceous cover at the site. Despite these declines, nine of the 16 cells (56%; Cells 1-5, 7, 8, 10, and 16) met the criteria of the habitat suitability model at all heights, and an additional three cells (Cells 6, 9, and 11) met the criteria at nearly all heights. Cover in the remaining cells (Cells 12-15), in the southern section of the restoration site, continues to progress more slowly in development of the canopy height and density typical of vireo habitat.

Vireo use of the restoration site in 2004 appeared to reflect the changes in foliage cover measured through vegetation sampling. Habitat in the northern cells, where cover increased, was divided among more territories (six, Figure 3) than in 2003 (two), with birds occupying habitat in Cell 1 (Pairs 16 and 17), Cell 2 (Pair 19), Cell 3 (Pairs 19 and 20), Cell 4 (Pair 20), and Cell 5 (Pair 21, Transient Pair 15).

2. 1998-2004

Vegetation cover at Pilgrim Creek generally changed only slightly between sequential years, but nearly doubled at heights below 5 m over the course of the study (Figure 6). The factors responsible for the increase in vegetative cover are unknown, but may be related to changed hydrology or the discontinuation of practices associated with the previous agricultural use of adjacent lands. In any case, riparian habitat along the creek has not been static, and annual measurement of vegetation structure has provided a current reference with which to compare vegetation development at the restoration site.

Overall, the restored vegetation changed dramatically between 1998, when vegetation sampling commenced, and 2004 (Figure 7). Canopy height increased from 4 m at the beginning of the study to greater than 8 m by the end, achieving the vertical profile of the reference habitat. Foliage cover increased throughout the canopy and by 2003 met the criteria of the habitat suitability model at all heights. These changes in canopy height and cover were evident in virtually every cell (Figure 8) despite variability among cells in their suitability as vireo habitat.

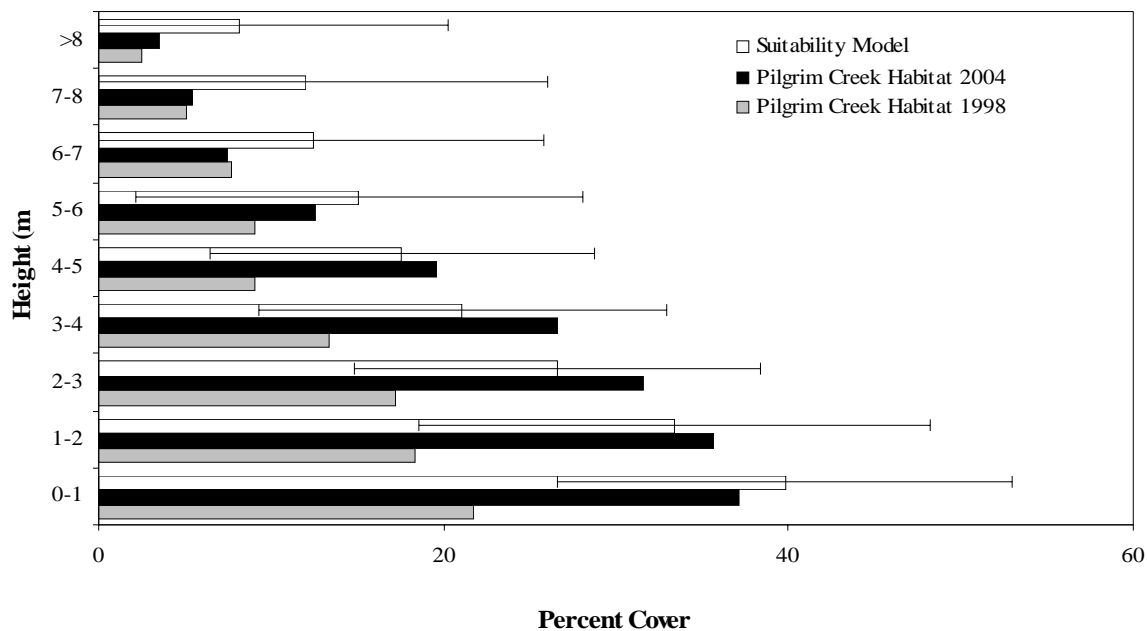


Figure 6. Average percent cover by height: Pilgrim Creek, 1998-2004.

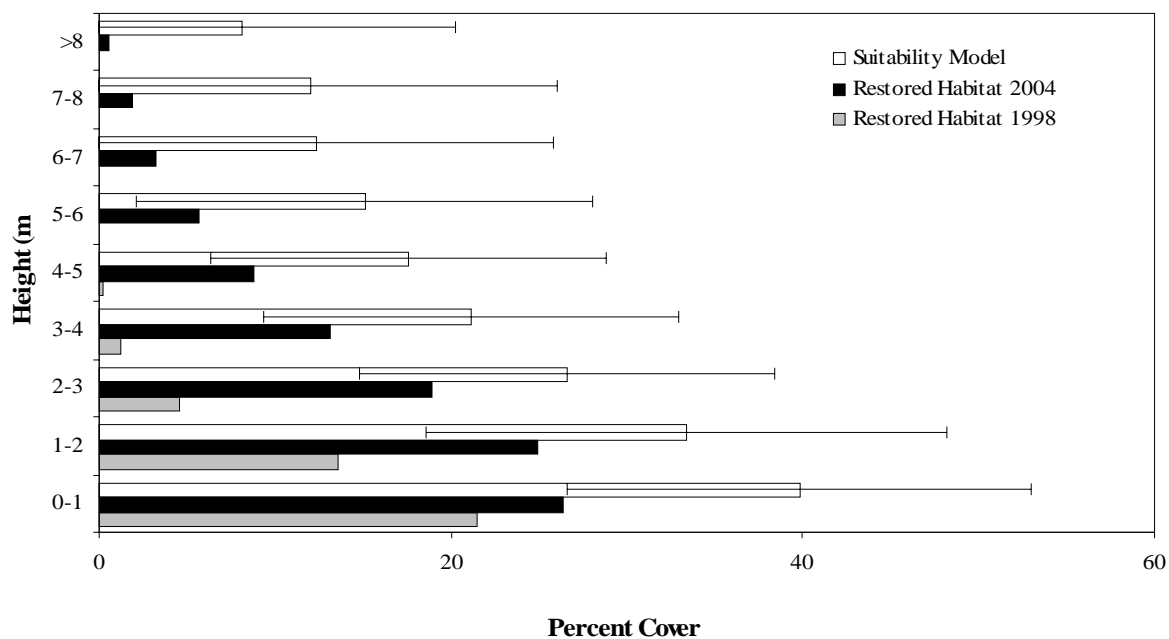


Figure 7. Average percent cover by height: restored habitat, 1998-2004.

Figure 8. Average percent cover by height of restored habitat: cell-by-cell assessment, 1998-2004

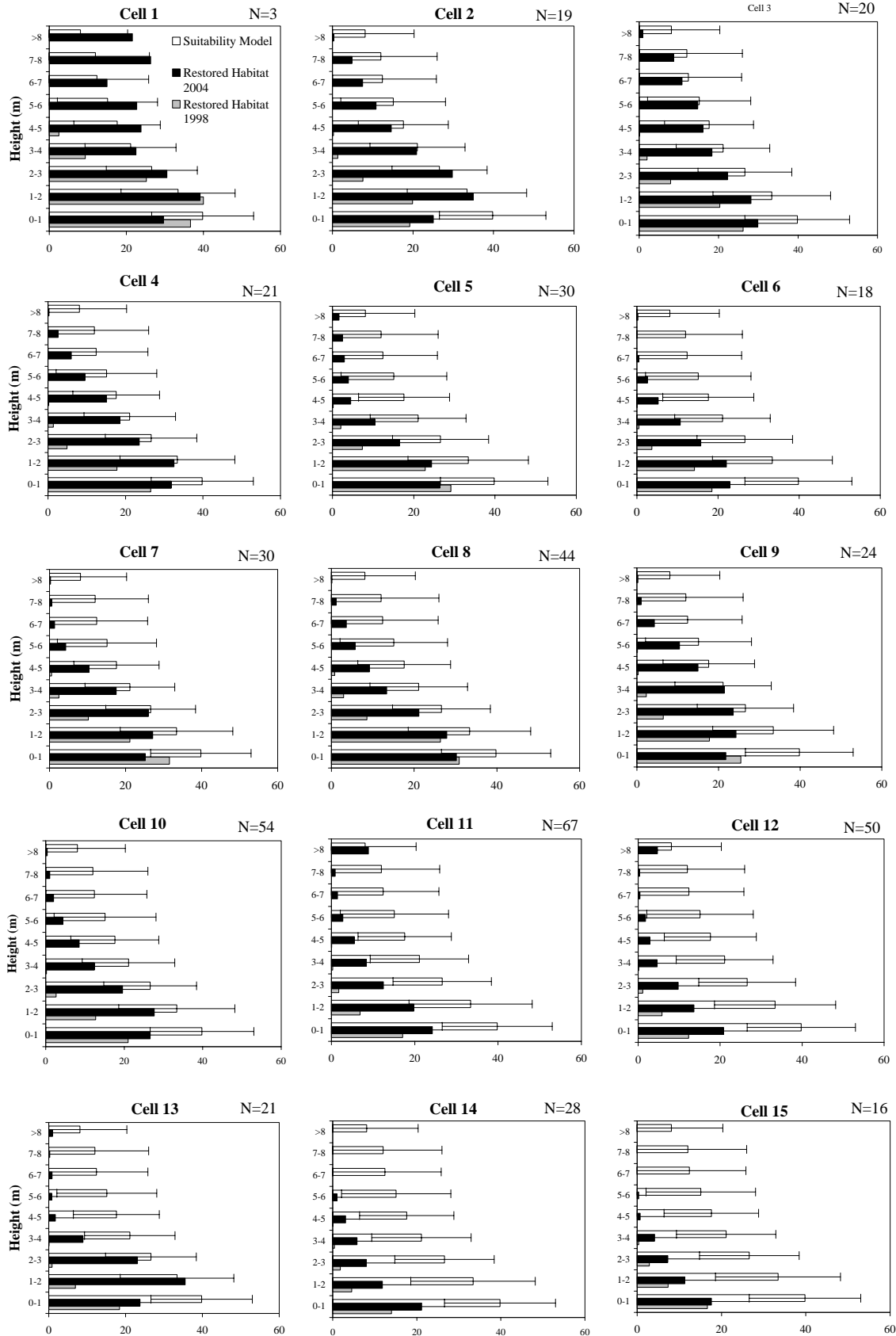
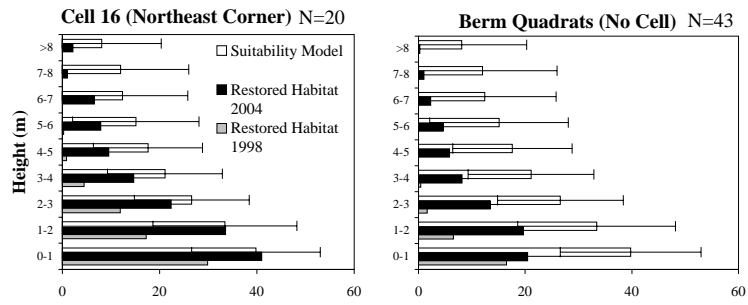


Figure 5 (cont.). Average percent cover by height of restored habitat: cell-by-cell assessment, 1998-2004.



IV. CONCLUSIONS

Our long-term observations of Least Bell's Vireos at Pilgrim Creek reveal a breeding population that has been generally stable and productive. Vireo numbers at the site in 2004 were roughly equivalent to those in 1986 when monitoring began, although numbers fluctuated during this period. Data collected over the 9-year study reveal annual variability in factors affecting population size, such as nest success and productivity. In some cases, the likely causes of the variability were evident, such as the exceptionally high precipitation in 1998 and the 2002 drought, which were associated with extremely high and low productivity, respectively. In other years, the sources of variability were less obvious. Regardless of the sources, vireos appear to be able to respond to favorable conditions and rebound quickly from years of reduced productivity, allowing them to maintain stable numbers long-term.

Vireo use of the restoration site increased steadily over the course of the study, reflecting the increased availability of habitat suitable for foraging and nesting. As has been observed at other sites (Kus 1998), vireos initially incorporated restored vegetation into territories that were largely situated in mature habitat, but eventually established territories entirely with the restoration site. By 2004, 35% of the Pilgrim Creek population was supported solely by restored habitat. Vireo use of the restoration site will likely increase as vegetation development continues. Periodic future monitoring will be valuable to further document the process of habitat development and colonization by vireos.

V. LITERATURE CITED

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APPENDIX 1. Nest success and productivity of Least Bell's Vireos, Pilgrim Creek, 1998-2004.

	Year								
	1996	1997	1998	1999	2000	2001	2002	2003	2004
Number territorial males	20	22	31	25	18	25	19	21	23
Number pairs	20	20	28	22	17	25	17	20	23
% nests successful	58	61	55	38	52	52	26	72	46
Average clutch size	3.3	3.5	3.5	3.4	3.6	3.6	3.0	3.6	3.6
Fledglings per pair	2.2	2.1	2.7	1.6	2.5	2.4	1.2	3.5	2.3
Fledglings per egg	0.53	0.62	0.56	0.35	0.49	0.52	0.39	0.64	0.48

Sources: Kus *et al.* 1999, 2000, 2001, 2002; Kus and Peterson 2002